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ABSTRACT

Population aging refers to an entire age structure becoming older. The age structure of a population is the result of three basic processes: fertility, mortality, and migration. Age structures reflect both past effects and current patterns of these processes. At the town, city, or regional level, migration becomes an important factor in raising the age level of the population, but in general the age structure of countries is more dependent on fertility and mortality. High fertility and high mortality ultimately produce a young population, while low fertility and low mortality in the long run produce an older population. A shift from high fertility and mortality to low fertility and mortality has accompanied industrialization in the developed world. Typically, mortality among the youngest age group declines first, resulting in a younger population. The population aging process begins when fertility declines. As mortality declines among the older age groups, the population ages further. It takes some time for the population to reach a stable age structure reflecting low fertility and mortality. Population aging around the world is inevitable for the 21st century. The demographic transition will require adjustment from social institutions. Four countries that exemplified the four stages of aging in 1985 are discussed (Nigeria, Brazil, Korea, and West Germany). Fifteen charts, graphs, and tables are provided to illustrate various aspects of this population aging process. A 9-item bibliography is included. (JB)

PATHS FOR FUTURE POPULATION AGING

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ABSTRACT

Developed countries with low fertility and mortality are already experiencing population aging and will continue to do so. Some developing countries in the middle of their demographic transitions are beginning to acknowledge the issues of population aging. The projected declines in fertility in other developing countries will mean substantial population aging in the future. Even in countries which are just beginning the demographic transition, the older population will grow dramatically, even faster than the rest of the population.

PATHS FOR FUTURE POPULATION AGING

The aging process usually refers to changes within individuals as they grow older. Measuring age at the individual level generally means chronological age, i.e., age at last birthday or age at nearest birthday. As a proxy for time or duration, age often acts as an independent variable. In contrast to individual aging, population aging refers to an entire age structure becoming older. While age is relatively straightforward to measure at the individual level, it is more complex for populations. How old is a population? What does it mean for a population to age? How does a population age?

Whereas chronological age at the individual level is usually an independent variable, population aging can serve as a dependent variable. The age structure of a population is the result of the three basic population processes: fertility, mortality and migration. When these processes are constant for many years, a stable age structure emerges (Coale, 1964). Changes in fertility, mortality or migration will produce immediate changes in the age structure, as well as long term effects. For example, the post-war baby boom of the United States initially made the population age structure younger. As the members of the baby boom cohort age, the U.S. population also ages, even if there are no future changes in fertility, mortality, or migration, due to the momentum inherent in the existing age structure (Myers, 1985). Age structures, therefore, reflect current patterns of fertility, mortality, and migration, as well as the effects of these processes in the past. Eventually, however, if fertility, mortality, and migration remain constant, a population "forgets its past" and develops a stable age structure determined entirely by the levels of fertility, mortality, and migration (Coale, 1964).

For most countries, fertility and mortality affect the age structure more than migration does, but at the town, city, or regional level, migration becomes

more important. The age structure of Madison, Wisconsin, for example, reflects the enormous migration of college-age persons who live there for four years or so, then leave. Florida has a fairly old age structure, not because of its fertility and mortality, but because older persons move there for retirement. The age structure of a country, however, depends more on fertility and mortality. High fertility and high mortality ultimately produce a young population, while low fertility and low mortality in the long run produce an older population.

The demographic transition refers to the predictable shift from high mortality and high fertility to low mortality and low fertility that has accompanied industrialization in the developed world. The typical pattern of a demographic transition is for mortality to decline first. Because mortality initially falls among the youngest age groups, the population age structure first grows younger, as more babies survive into childhood. The population aging process begins when fertility declines, as each woman on average has fewer children. In the final stage of the demographic transition, mortality declines favor the older ages and contribute to further population aging. Even after fertility and mortality have stopped declining, the age structure needs some time to adjust to the new levels, and therefore the aging process continues until the population reflects only the continuing low levels of fertility and mortality. In this post-transition stage, moreover, fertility tends to fluctuate (producing baby booms and baby busts) which have both an immediate and longer term impact on the age structure (Coale, 1974).

Just as there are examples of countries at various stages of the demographic transition, there are four stages of population aging illustrated in the world today. First, in most of Africa and some parts of Asia and Latin America, mortality is still moderately high (life expectancy at birth of 50

years) and fertility has not yet begun to fall. For these countries, the age structure is growing younger and will continue to do so unless fertility declines. The second stage of population aging will occur in Asian and Latin American countries where fertility declines are beginning to take place, setting a foundation for significant population aging in the 21st century. The third stage of population aging is occurring in several developing countries, particularly in Asia that have recently experienced fertility and mortality declines. Their demographic transition has occurred much more rapidly than that of the Western world, and consequently, population aging will take place more quickly, too (U.S. Census, 1987; Martin, 1988). A notable example of extreme population aging during the early part of the 21st century is China (Grigsby and Olshansky, 1989). Finally, in the developed world where most societies have completed the demographic transition to low rates of mortality and fertility, population aging is well underway already and moreover will continue into the next century. While the issue of population aging has already come to the attention of societies in the latter two stages, there are important reasons for countries in the initial stages of population aging to begin to address these concerns as well.

Examples of Population Aging

One way to display the age structures of populations is with population pyramids. Figures 1a-d show the age structures of four countries in 1985 that exemplify the four stages of aging. In Nigeria, mortality has begun to fall, but fertility is still high, thus the population is quite young. The broadened base of Nigeria's population pyramid reflects its recent declines in mortality at the younger ages. Brazil is further along in the demographic transition, as fertility and mortality are both lower than in Nigeria, yet Brazil's age

structure also looks fairly young, although the base of the pyramid is beginning to narrow as fertility declines. Korea[1] has experienced dramatic declines in fertility and mortality in the last two decades. Hence its age structure is somewhat older than Brazil's, particularly at the younger ages, where the pyramid looks more rectangular. West Germany's[2] population represents a post-transition society, where fertility and mortality are both low, although fluctuations in fertility can produce bumps in the age structure, so that the population "pyramid" can resemble an hourglass rather than a rectangle.

These four populations were projected forward to the year 2025 (Figures 2a-d), using medium level fertility and mortality rates from the United Nations (Appendix 1). Even with fertility projected to decline, Nigeria's population pyramid demonstrates that the age structure will remain relatively young. Brazil's population age structure in 2025 also will continue to resemble a pyramid, although it shows swelling in the upper ages. By 2025, Korea's age structure will become a rectangular one, except for the relatively smaller birth cohorts at the oldest ages. West Germany's age structure, which in 1985 began to resemble an inverted pyramid due to extremely low fertility, should revert to rectangular shape as fertility rises to replacement level over the next forty years, although some demographers doubt that fertility in developed societies will increase this much (Westoff, 1983).

There are other ways to measure population aging besides constructing age-sex pyramids (Shryock and Siegal, 1976, p. 113-144). The most common measure of population aging is the proportion or percent of the population that is "aged", although countries vary in their definition of which age marks old age. In some

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1 Refers to The Republic of Korea, or South Korea.
2 Refers to the Federal Republic of Germany.

countries, retirement (particularly for women) can be as early as age 55, although ages 60 or 65 are more typical retirement ages. Even in the United States, programs and services use different chronological markers of old age (Binstock, et al., 1983). For international comparisons, the U.S. Census Bureau (1987) refers to persons age 55 and over as "older," persons 65 and over are "elderly," and persons age 80 and over are the "oldest old."

The top panel of Table 1 shows the proportion of the population over ages 55, 60, 65, 70, 75 and 80 for the 1985 populations and for the projected populations in 2025. These measures, along with the pyramids, indicate that West Germany's age structure is the oldest, followed by Korea, Brazil, and Nigeria. While only 6.5 percent of Nigeria's population is age 55 and over in 1985, almost one-third of West Germany's population is in this age group. By 2025 almost forty percent of West Germany's population will be age 55 and older. The proportion of Korea's population in each older age group will more than double by 2025, another indicator that Korea will experience the greatest amount of aging of the four countries. Close to five percent of Korea's 1985 population is age 65 and over, increasing to 13 percent by 2025.

As the proportion of the population that is older increases, the older population itself also ages, as shown in the second panel of Table 1. In Nigeria approximately one-fourth of the elderly population is age 75 and over. Brazil's and Korea's elderly populations are somewhat older than Nigeria's. Close to one-half of Germany's elderly population is age 75 and over. The proportion of the elderly population that is in the "oldest old" category ranges from 9 percent in Nigeria to 21.9 percent in Germany. Because their older

populations are already fairly old, Brazil's and West Germany's older populations will become somewhat younger between 1985 and 2025. The elderly populations in Nigeria and Korea, however, will age, with substantial increases in the age group 80 and older.

Measures of population aging that take into account age groups other than older ones also show a consistent pattern (see the third panel of Table 1). Populations with high proportions of older persons tend to have relatively lower proportions of younger persons. In Nigeria, Brazil, and Korea, the proportion of the population under age 15 is projected to decline by 2025. In West Germany, the younger population should increase because fertility is projected to rise from its current below-replacement level to replacement-level. The "working-age" populations, ages 15-64, will increase proportionately in Nigeria, Brazil, and Korea and decline somewhat in West Germany. The process of population aging in general does not change the proportional size of the middle age group as much as it changes the relative size of the youngest and the oldest ages. An older population usually has a larger proportional of persons in the working ages than a younger population does.

Indeed, the aged/youth ratio, with the older population in the numerator and the younger population in the denominator, arguably provides the best indicator of population aging. It is very small in young populations and very large in old populations. The aged/youth ratio shows how much further along West Germany is in the aging process than the other three countries. There are 116 elderly persons for each younger person in West Germany, while the comparable values for the other three countries are all less than 20. Like other measures, this one shows that Korea will experience the greatest amount of aging between 1985 and 2025, as its aged/youth ratio will quadruple.

In contrast, the dependency ratio, with the young and old populations in

the numerator and the "working age" population in the denominator, is much less sensitive to changes in the age structure. In 1985 Nigeria, the youngest population, has the largest dependency ratio, and West Germany, the oldest population, has the smallest. By 2025, however, the dependency ratios of these four countries show no clear pattern and do not differ greatly from one another. Korea has the smallest dependency ratio in 2025, while West Germany's is the largest, but only slightly larger than Nigeria and Brazil's. Population aging, therefore, tends to decrease the dependency ratio; however, the final stage of the demographic transition, when fluctuations in fertility along with mortality improvements in the oldest ages, can bring about increases in the dependency ratio.

For a summary measure of age structure, a convenient statistic is the median age, the age at which half the population is older and half is younger. Like the aged/youth ratio, the median age of West Germany's population is greater by far than the other three countries, while Korea's median age will experience the greatest increase over the next forty years.

The last two measures in Table 1 measure change in the age structure rather than aging, per se. Both the index of relative difference and the index of dissimilarity show that Korea will experience the greatest change in age structure. The two indexes do not show any consistent rankings on the amount of change in age structure for the other three countries.

Population aging generally refers to proportional increases in the older population. Another important outcome is the growth in numbers of the older population. In 1985, West Germany has the largest number of persons age 65 and older of the four countries, although the growth of its older population will level off in the next century. Around 2010, however, Brazil's elderly population will surpass it in size and continue to grow in an exponential

fashion (see Figure 3). Nigeria and Korea will also experience exponential growth among the elderly population. In fact, in all four countries, the elderly population is projected to increase faster than either the younger age group or the "working age" population (Grigsby, 1988).

The oldest old populations (ages 80 and older) are projected to increase at even faster rates than the 65 and older populations over the next forty years. Between 1985 and 2025 the size of the oldest old population in West Germany fluctuates, reflecting the fluctuating fertility rates in the middle of the 20th century. By 2025 the oldest old population in Brazil is expected to grow almost two and half times its size in 1985. In Korea and Nigeria, the 80 and older age group will quadruple by 2025 (Figure 4).

Components of Population Aging

There is incontrovertible evidence of substantial aging in each of these four countries over the next forty years. How much of it is a function of the projected changes in fertility and mortality? How much of it would occur even if fertility and mortality did not change from their 1985 values? It is possible to decompose the changes in the proportion of the population age 65 and older into three factors: changes in fertility, changes in mortality, and the built-in momentum of the current age structure and vital rates (assuming negligible levels of international migration) . While it is possible to separate the effect of the current age structure from the current vital rates, they are combined here (see Grigsby, 1988 for derivations of all four factors).

For Nigeria the projected decline in fertility will contribute most to the increase in the population age 65 and older. Projected mortality declines will also add somewhat to further aging. If there were no change in fertility or mortality between 1985 and 2025, the proportion of the population age 65 and

older would actually decline, as the population would experience relatively high fertility combined with moderately low mortality, making for a younger population (see Figure 5).

Brazil's population is expected to age as a result of all three factors contributing to a larger elderly population. The built-in momentum for aging is projected to have the greatest effect, followed by the fertility decline, and then the mortality decline (see Figure 6).

Korea, which has already experienced large declines in fertility and mortality, has a tremendous momentum for further population aging. Even if fertility and mortality remain at 1985 levels, the elderly population will grow substantially. The projected declines in fertility and mortality will also add to the momentum for even further population aging (see Figure 7).

Like Korea, West Germany has a large built-in momentum for future population aging. The projected changes in mortality should also contribute to proportional growth in the elderly population. The projected increase in fertility, to replacement-level, however, will temper the amount of population aging by 2025. Nevertheless, West Germany's population age 65 and older will still increase as a proportion of the total population (see Figure 8).

Discussion

Over the next forty years, population aging is projected to take place in all parts of the world, not just in the more developed countries. Countries like Nigeria that are beginning their demographic transition face rapid population growth of their entire populations, with even faster rates of growth in the older age groups. Even though the shape of Nigeria's age pyramid will not change substantially before the middle of the next century, the number of older persons will approach that of West Germany. Brazil, a country that has

already experienced a moderate decline in fertility, is projected to age even if no further declines in fertility or mortality take place. Because it is such a large country, during the early part of the next century Brazil will also have one of largest elderly populations of the world. While the age structures of Nigeria and Brazil will still appear fairly young, the large number of older persons in each country should bring gerontological issues come to the forefront of policy.

Of the four countries, Korea is projected to have the greatest amount of population aging. By 2025, Korea's age structure will be rectangular, as it will have joined the ranks of developed countries that have completed the demographic transition. This population aging process will continue in Korea even after fertility and mortality have reached their low levels, because it takes time for the age structure to adjust to changes in vital rates.

While West Germany is already a fairly old country today, it will age even further over the next forty years, despite the projected increases in fertility. If fertility does not return to replacement level, which is highly possible, then West Germany will experience even greater population aging.

Projected mortality declines at the older ages mean that in all four countries, the older population will itself grow older. The oldest old population (ages 80 and older) will experience greater growth than any other age group in all four countries. Not only will all four countries need to address general issues of population aging, but more specifically the even greater needs of the oldest old population.

While population aging often connotes negative images, it also generally results in an overall lower dependency ratio, due to the large decline in the population under age 15, an age group that requires a large investment of societal resources. Furthermore, in the early stages of population aging, the

working age population increases proportionally, thus facilitating the transition of the dependent population from the younger to the older ages, which can require a shift in the public and private sectors.

Population aging around the world is inevitable for the 21st century, given current projections of declining fertility and mortality.[3] Demographic changes that have already occurred have created a momentum for aging in the developed world and in several developi. untries, such that any changes in fertility and mortality will have a relatively small effect on the age structure. Reversing population aging would require an increase in mortality or fertility. There is no question that raising mortality is undesirable, but raising fertility may be just as unviable. First of all, once fertility has reached low levels, it is very difficult to encourage individuals to have larger families (Westoff, 1983). Moreover, raising fertility means creating a baby boom birth cohort which U.S. experience has shown can be difficult for a society to absorb. When the size of birth cohorts fluctuates, social institutions like hospitals, schools, prisons, and the economy must continually adjust. Raising fertility will also cause a short term rise in the overall dependency ratio by increasing the proportion of younger persons. Finally, as the projections for West Germany show, a rise in fertility is not going to reverse population aging, just moderate it. Population aging, therefore, should not be something that countries should try to avoid, but rather an outcome of desirable demographic progress that nevertheless requires adjustment from social institutions.

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3 The United Nations projections do not include any possible effect of the AIDS epidemic on mortality or fertility levels, nor do they anticipate fluctuations in fertility rates that have been observed in the developed world.

Nigeria, 1985

Percent of Population

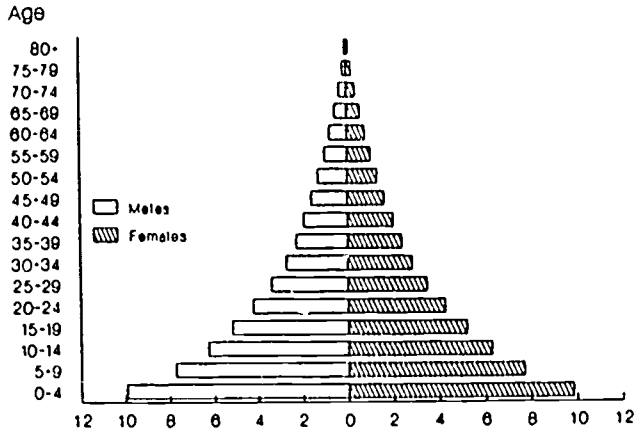

Figure 1a

Brazil, 1985

Percent of Population

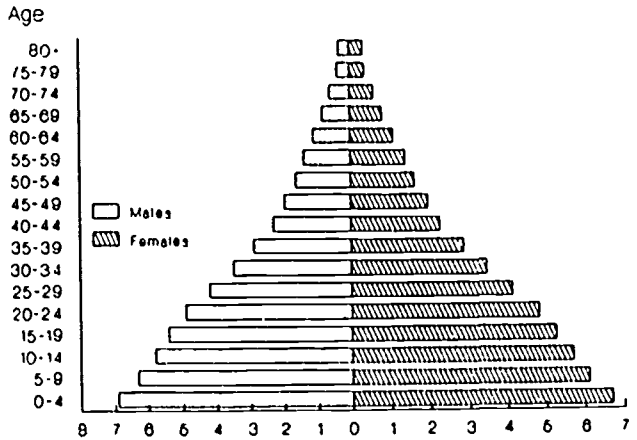

Figure 1b

Korea, 1985

Percent of Population

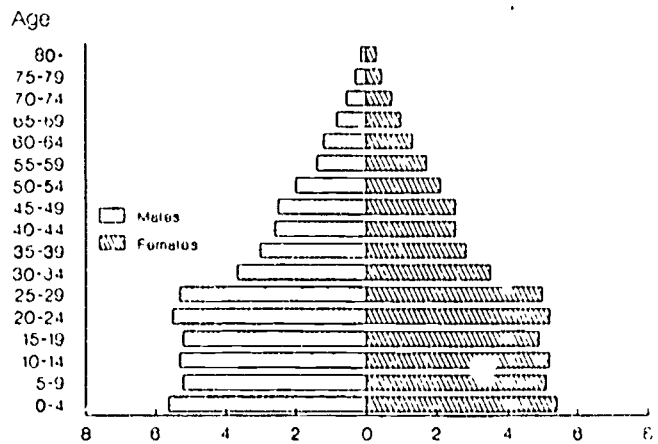

Figure 1c

West Germany, 1985

Percent of Population

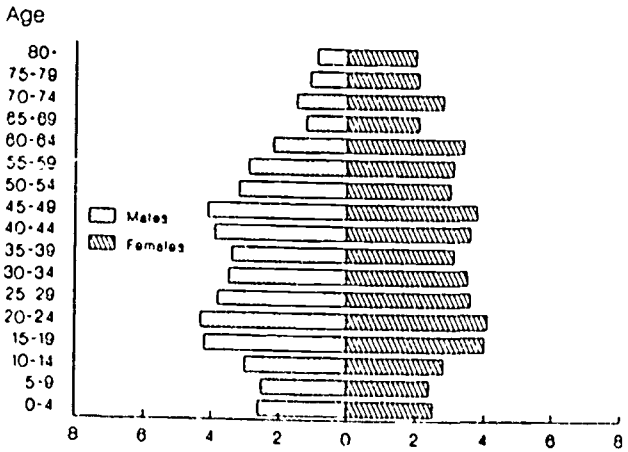

Figure 1d

Nigeria, 2025

Percent of Population

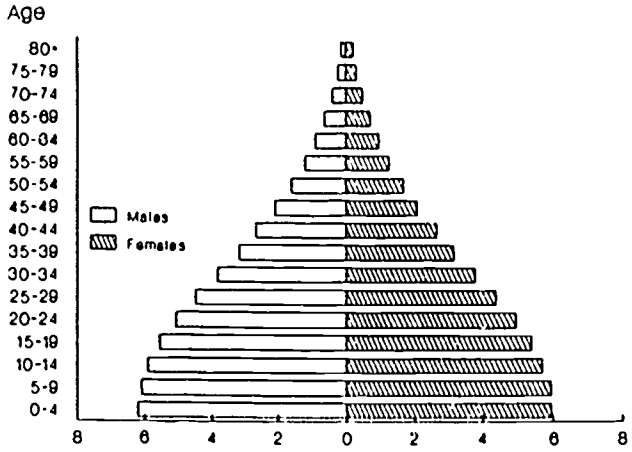

Figure 2a

Brazil, 2025

Percent of Population

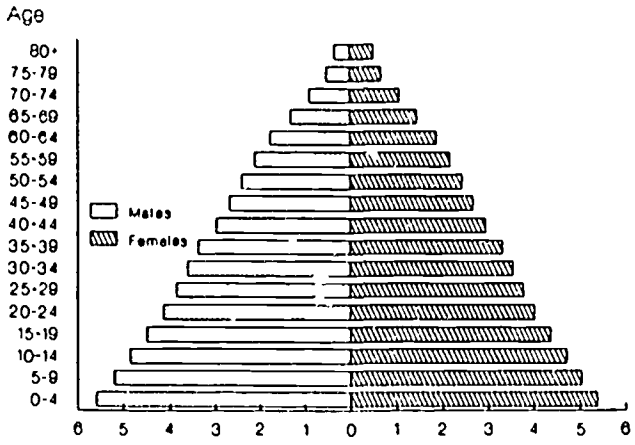

Figure 2b

Korea, 2025

Percent of Population

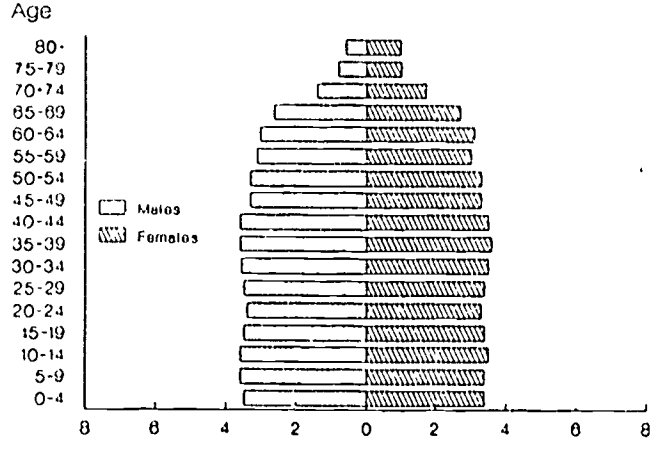

Figure 2c

West Germany, 2025

Percent of Population

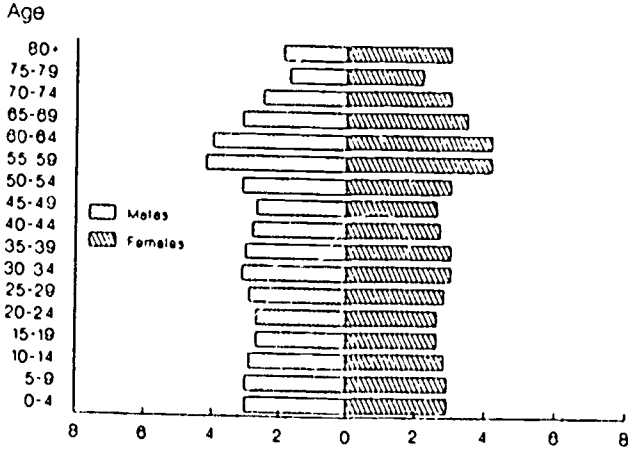

Figure 2d

Future Growth of the Older Population

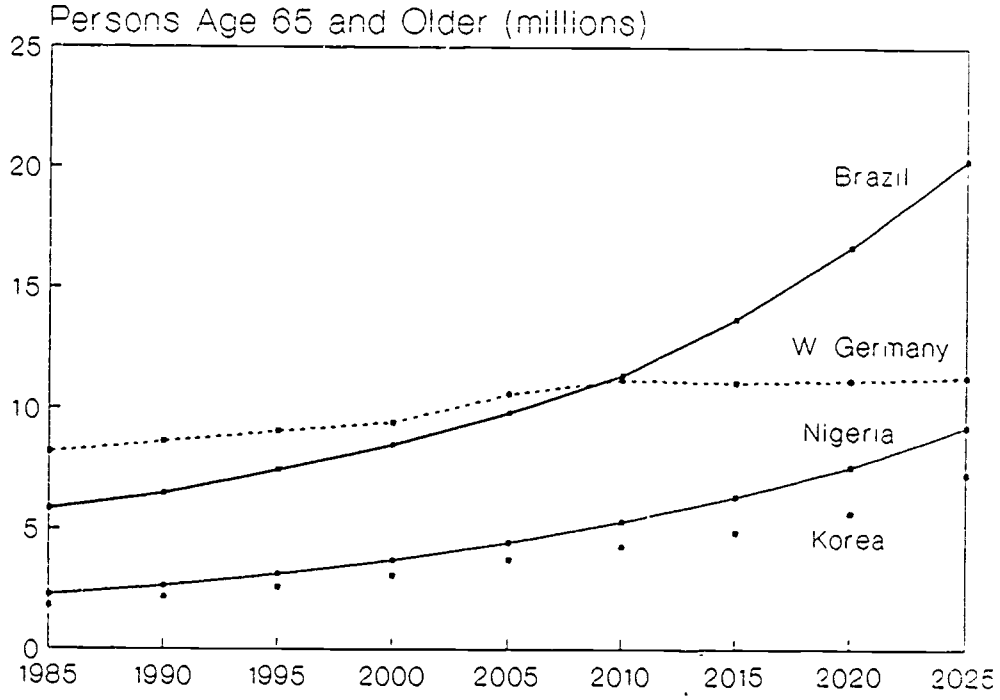

Figure 3. Future Growth of the Older Population: Nigeria, Brazil, Korea, West Germany, 1985-2025

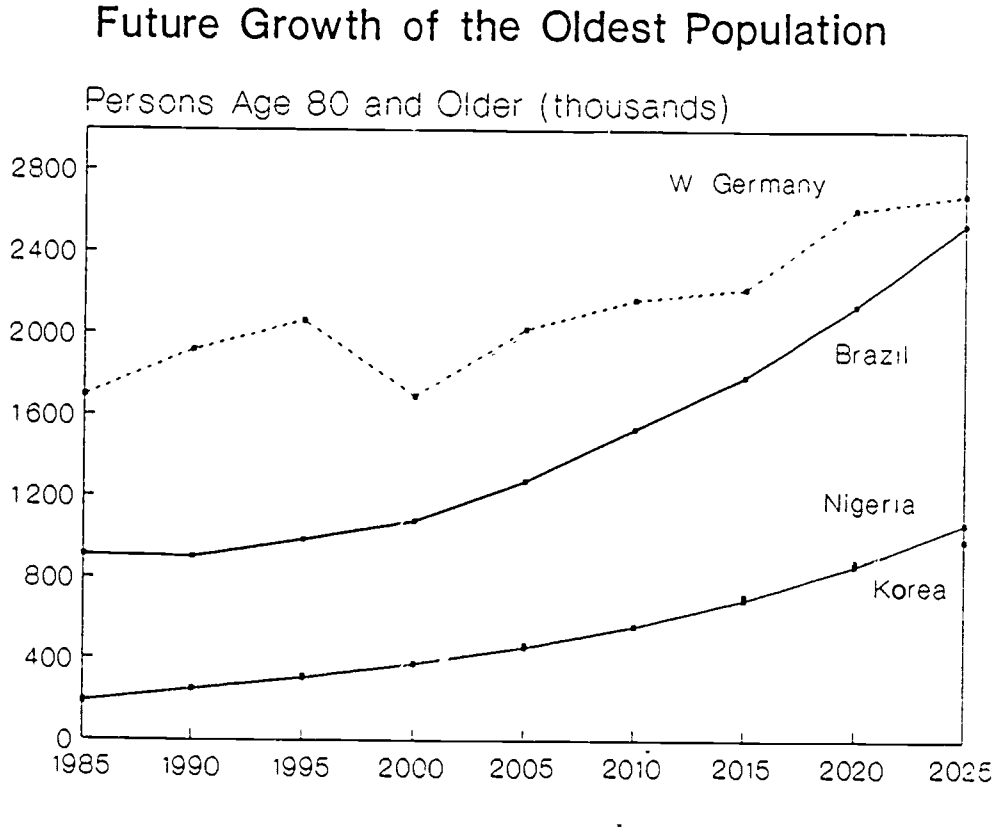

Figure 4. Future Growth of the Oldest Population: Nigeria, Brazil, Korea, West Germany: 1985-2025

Components of Population Aging
Nigeria, 1985 - 2025

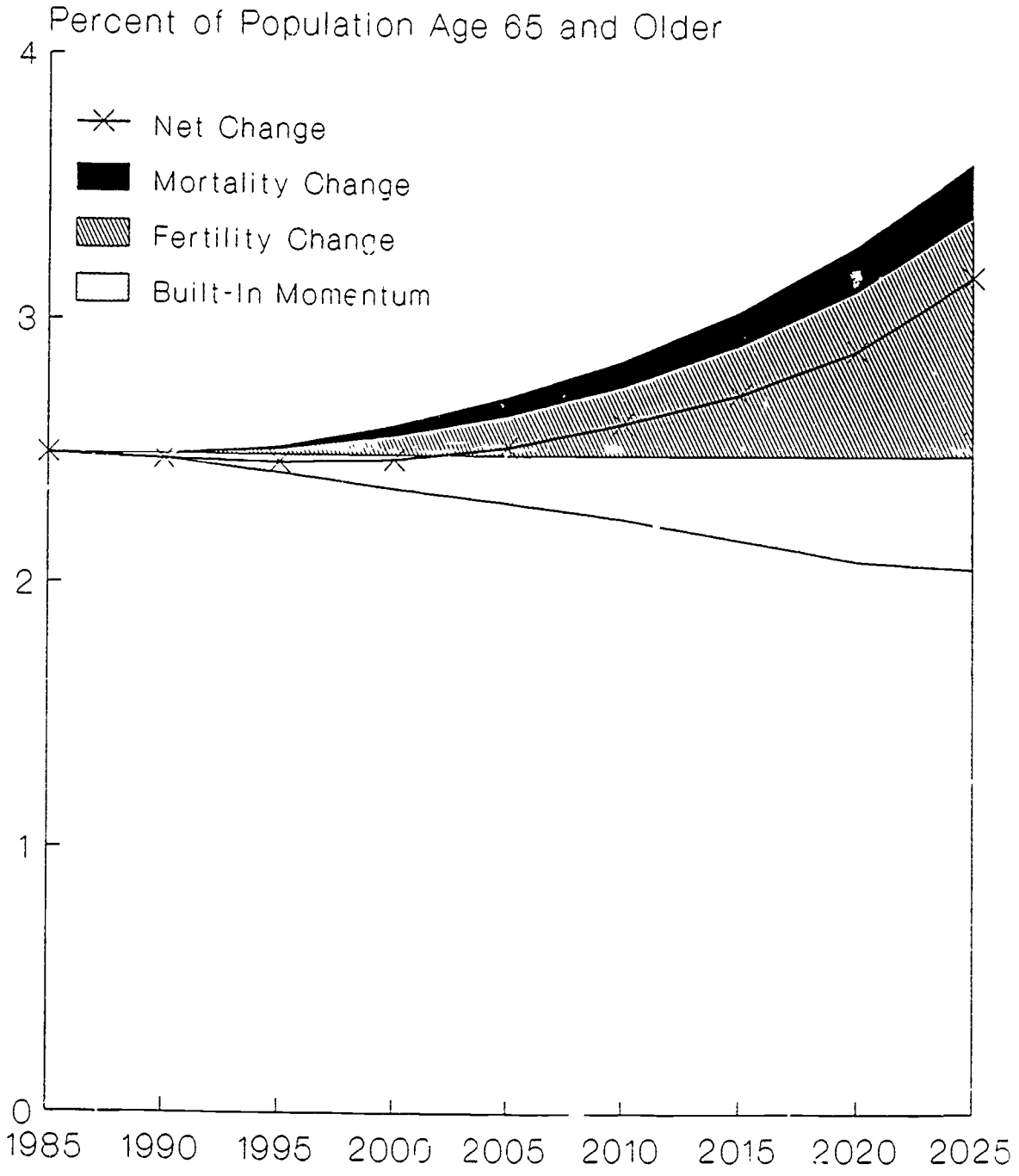

Figure 5. Components of Population Aging: Nigeria, 1985-2025

Components of Population Aging
Brazil, 1985 - 2025

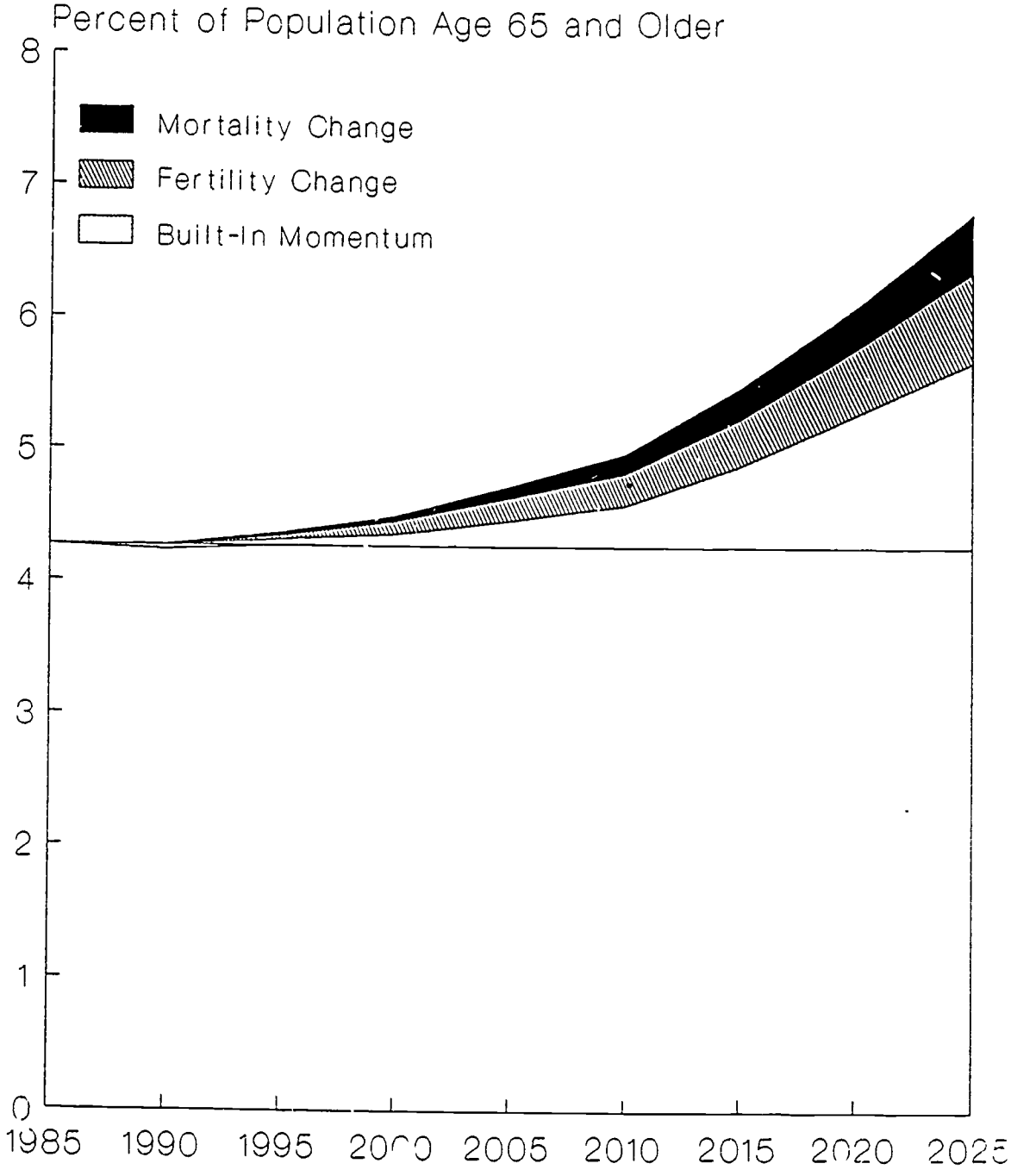

Figure 6. Components of Population Aging: Brazil, 1985-2025

Components of Population Aging
Korea, 1985 - 2025

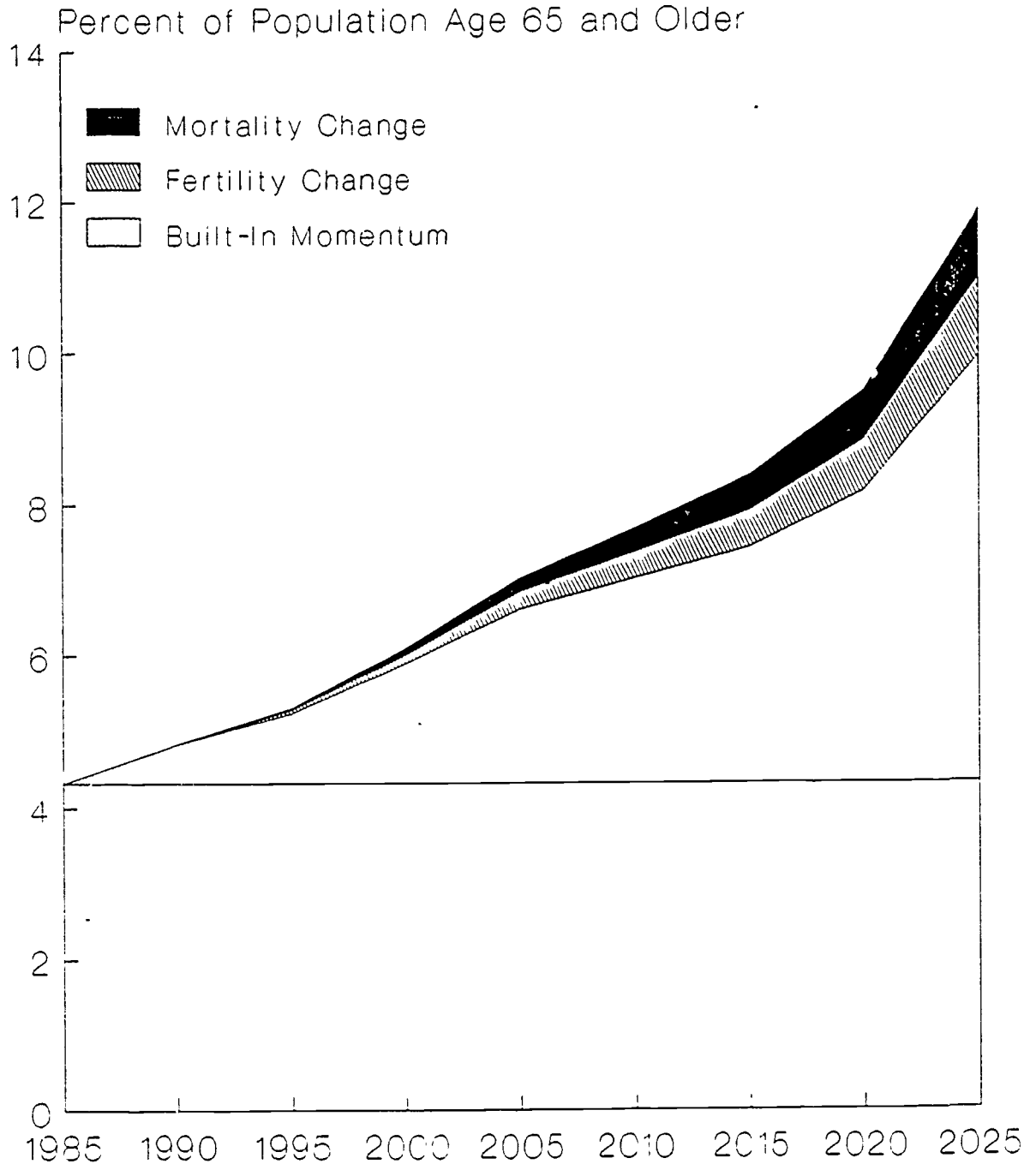

Figure 7. Components of Population Aging, Korea: 1985-2025

Components of Population Aging
West Germany, 1985-2025

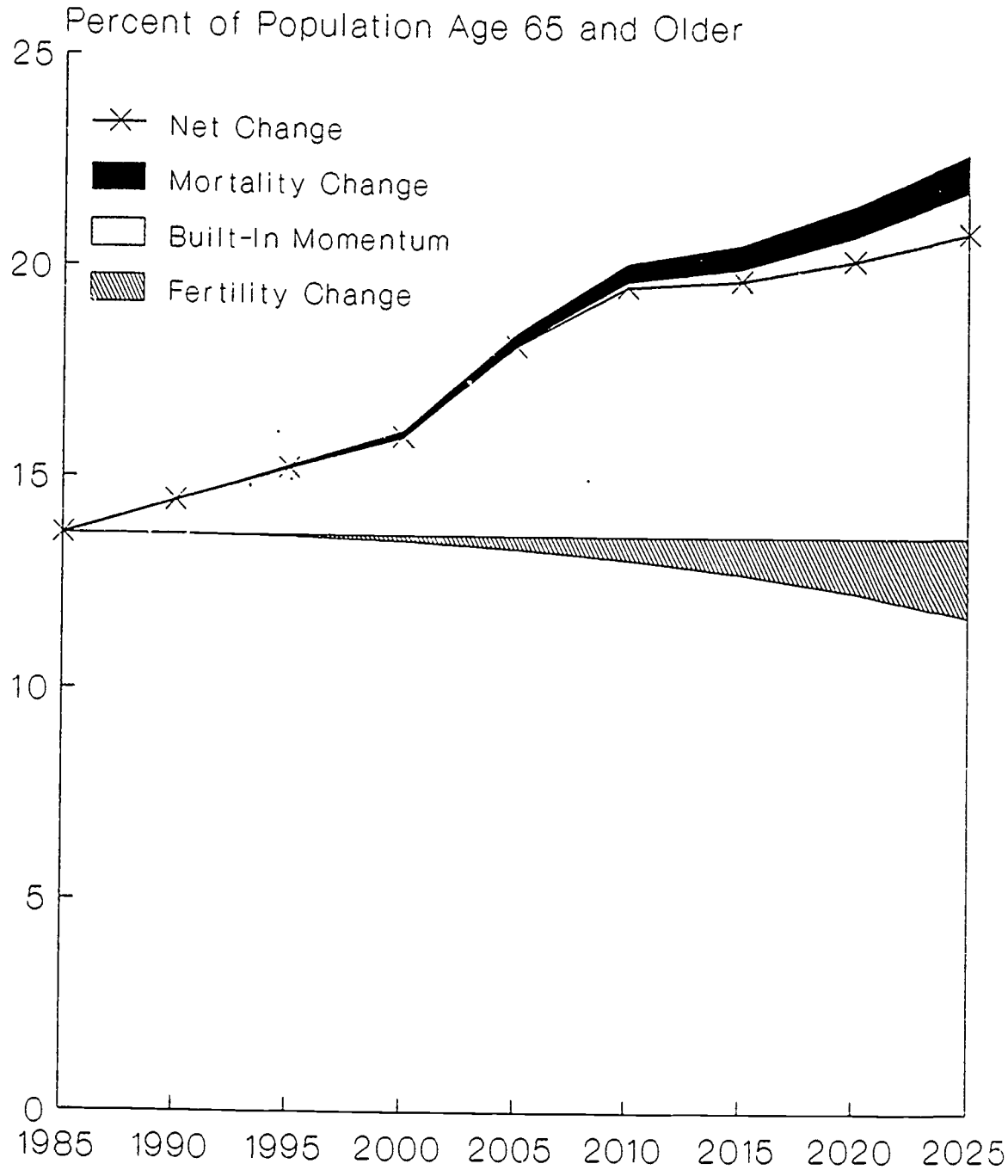

Figure 8. Components of Population Aging: West Germany, 1985-2025

Table 1. Alternative Measures of Population Aging for Brazil, Nigeria, South Korea, and West Germany, 1985 and 2025

	1985 estimates				2025 projections			
	Nigeria	Brazil	Korea	W.Germany	Nigeria	Brazil	Korea	W.Germany
Percentage 55+	6.5	9.4	10.9	29.8	8.2	15.6	25.0	39.3
Percentage 60+	4.4	6.6	7.6	23.7	5.6	11.3	18.9	31.1
Percentage 65+	2.7	4.4	4.9	17.2	3.6	7.5	12.8	22.9
Percentage 70+	1.5	2.7	3.0	13.3	2.1	4.5	7.4	16.1
Percentage 75+	0.7	1.5	1.5	7.9	1.1	2.4	4.0	10.2
Percentage 80+	0.2	0.7	0.6	3.8	0.5	1.0	1.9	6.0
(Pop. 75+)/(Pop. 65+)	25.9	33.9	30.6	45.9	29.9	31.9	31.4	44.7
(Pop. 80+)/(Pop. 65+)	9.0	16.0	11.8	21.9	12.6	13.8	15.1	26.1
Percent Age 0-14	47.2	37.4	31.5	14.8	35.3	30.3	20.6	16.7
Percent Age 15-64	50.1	58.3	63.6	68.0	61.1	62.3	66.6	60.5
Aged/Youth Ratio[1]	5.8	11.7	15.6	116.2	10.0	24.8	62.3	137.2
Dependency Ratio[2]	99.8	71.7	57.1	47.2	63.6	60.6	50.1	65.4
Median Age	16.3	21.1	24.1	40.0	21.9	27.0	36.6	45.4
Index of Relative Difference	--	--	--	--	14.1	18.3	36.3	11.9
Index of Dissimilarity	--	--	--	--	11.9	11.4	21.3	11.6

1. (Population 65+)/(Population 0-14)
2. [(Population 0-14) + Population 65+)]/(Population 15-64)

REFERENCES

Binstock, Robert H., Grigsby, Jill S., and Leavitt Thomas. (1984). Targeting strategies under Title III of the Older Americans Act. Waltham, MA: Working Paper No. 16 of the National Aging Policy Center on Income Maintenance, Brandeis University.

Coale, Ansley J. (1964). How a population ages or grows younger. In R. Freedman (Ed.), Population: the vital revolution. New York: Doubleday.

Coale, Ansley J. (1974). The history of the human population. Scientific American, 231,9: 15-25.

Grigsby, Jill S. (1988). The demographic components of population. Ann Arbor, MI: Working paper 88-124, Population Studies Center, University of Michigan.

Grigsby, Jill S. and S. Jay Olshansky (1989). The demographic components of population aging in China. Journal of Cross-Cultural Gerontology, forthcoming.

Martin, Linda G. (1988). The aging of Asia. Journal of Gerontology: Social Sciences,43, S99-113.

Myers, George C. (1985). Aging and worldwide population change. In R. Binstock and E. Shanas (Ed.), Handbook of aging and the social sciences. New York: Van Nostrand.

Shryock, Henry S., Siegel, Jacob S. and Associates. (1976). The methods and materials of demography. New York: Academic Press.

Westoff, Charles F. (1983). Fertility decline in the West: causes and prospects. Population and Development Review 9, 99-104.

Appendix 1. Population Projection Parameters: Nigeria, Brazil, Korea, West Germany, 1985-2025[a]

Measure	Nigeria	Brazil	Korea	W.Germany
Total Fertility Rate[b]				
1985-90	6.68	3.67	2.46	1.48
1990-95	6.34	3.42	2.25	1.57
1995-00	5.88	3.28	2.15	1.65
2000-05	5.34	3.18	2.05	1.77
2010-15	4.19	3.10	2.05	1.98
2020-25	3.05	3.05	2.05	2.10
Female Life Expectancy[c]				
1985-90	54.3	67.0	68.5	76.6
1990-95	56.8	68.4	70.0	77.3
1995-00	59.4	69.7	71.3	77.7
2000-05	61.6	70.9	72.7	77.8
2010-15	65.8	73.0	74.7	78.2
2020-25	69.6	74.8	76.2	78.6

a. See Grigsby (1988) for the methodology of the projections.
b. The number of children a woman would have if she were to go through the childbearing years experiencing the age-specific fertility rates of that period
c. The number of years a female infant born during that period can expect to live